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GRADUATE ENGINEERING EDUCATION VIA TELEVISION.

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THE UNIVERSITY OF FLORIDA COLLEGE OF ENGINEERING INSTALLED IN 1964 A CLOSED CIRCUIT TV NETWORK INTERLOCKING GAINESVILLE, DAYTONA BEACH, ORLANDO, AND PORT CANAVERAL TO PROVIDE GRADUATE ENGINEERING EDUCATION TO A GREATER NUMBER OF STUDENTS, MAINLY EMPLOYEES OF INDUSTRIES. CENTERS ARE CONNECTED THROUGH INTERCITY MICROWAVE CIRCUITS, EACH CIRCUIT CARRYING ONE VIDEO AND TWO AUDIO CHANNELS. LECTURES AND DEMONSTRATIONS ORIGINATING FROM EACH CENTER MAY BE SWITCHED INTO THE MICROWAVE TRANSMISSION. WHILE THE PROFESSOR DELIVERING THE LECTURE HAS A LIVE CLASS IN FRONT OF HIM IN THE STUDIO, THE LECTURE IS ALSO TELEVISED TO THE VARIOUS CENTERS WHERE STUDENTS WHAT TO TAKE THE COURSE. A MONITOR ALLOWS HIM TO SEE WHAT IS GOING OVER THE SYSTEM, AND THE TWO-WAY AUDIO SYSTEM ALLOWS STUDENTS, REGARDLESS OF LOCATION, TO ASK QUESTIONS AND HEAR THE ANSWERS. QUIZZES ARE PREPARED BY THE LECTURER, MAILED TO CENTERS WHERE THE RESIDENT FACULTY HAND THEM OUT, COLLECT THEM, AND SEND THEM BACK FOR GRADING. A COST ANALYSIS INDICATES THAT IN TERMS OF COST PER STUDENT SEMESTER HOUR, THE EXPENSES ARE APPROXIMATELY THE SAME AS THOSE FOR A GAINESVILLE ON-CAMPUS PROGRAM. CLASSES HAVE EXPANDED FROM AN INITIAL ENROLLMENT OF 32 IN 1964 TO AN ENROLLMENT OF 349 IN 1968. 97 DEGREES HAVE BEEN CONFERRED. THIS PAPER WAS PREPARED FOR PRESENTATION TO THE 1968 INTERNATIONAL CONVENTION OF THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (NEW YORK, MARCH 18, 1968). (JO)

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GRADUATE ENGINEERING EDUCATION VIA TELEVISION

by

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Gainesville, Florida

For presentation to the 1968 International Convention of
the Institute of Electrical and Electronics Engineers
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Introduction

For many years the industries of the state of Florida persisted in their request that graduate engineering education be made available to their employees. Since the University of Florida conducted the only graduate engineering programs in the State until quite recently, it was the obvious responsibility of the College of Engineering at the University of Florida to provide the much needed courses.

Even though the College was already providing a Master of Engineering program in three industrial areas of the State with all of the course work taken at those locations, pressure from the industries brought about the 1963 State Legislative Act which extended the campus of the College of Engineering into the East Central Florida area and stated that the College was to provide graduate engineering education leading to the Master's and Doctor's degrees. The act also provided funds for the establishment of facilities and for two years of operating expenses.

The study made after the passage of the act showed that placing one large center in one location would make the graduate program available to a maximum of only about 25 percent of the potential students in the area covered by the act. The College administration decided that industry would benefit much more if there were several campuses at appropriate locations.

It was also recognized that the resources of all the graduate faculty at the University of Florida could be made available to the expanded campus of the College of Engineering by using closed circuit television.

To implement this act and provide graduate engineering education to the greatest number of students, the College installed a closed circuit TV network interlocking Gainesville, Daytona Beach, Orlando, and Port Canaveral. Figure 1 shows the location of these connected campuses and indicates the distances between them. It is well to note that a provision was made which allows agencies of government or industry to set up a receiving room in its own facility so that the students do not have to travel to the nearest center during the working day.

This paper is a general description of the facilities, operating procedures, and a report on the operating experience during the past three years.

Facilities

The facilities available at Gainesville consist of one studio-lecture room as shown in Figure 2 and three monitoring classrooms where students can view the courses presented over the network using conventional TV sets. These are located in the main Engineering and Industries Building. There is a mobile console with a zoom lens camera with pan and scan that is used in some of the laboratory courses, especially the analog and hybrid computer laboratory, and in the Engineering Auditorium. A more complete description of the TV equipment is given in Appendix A.

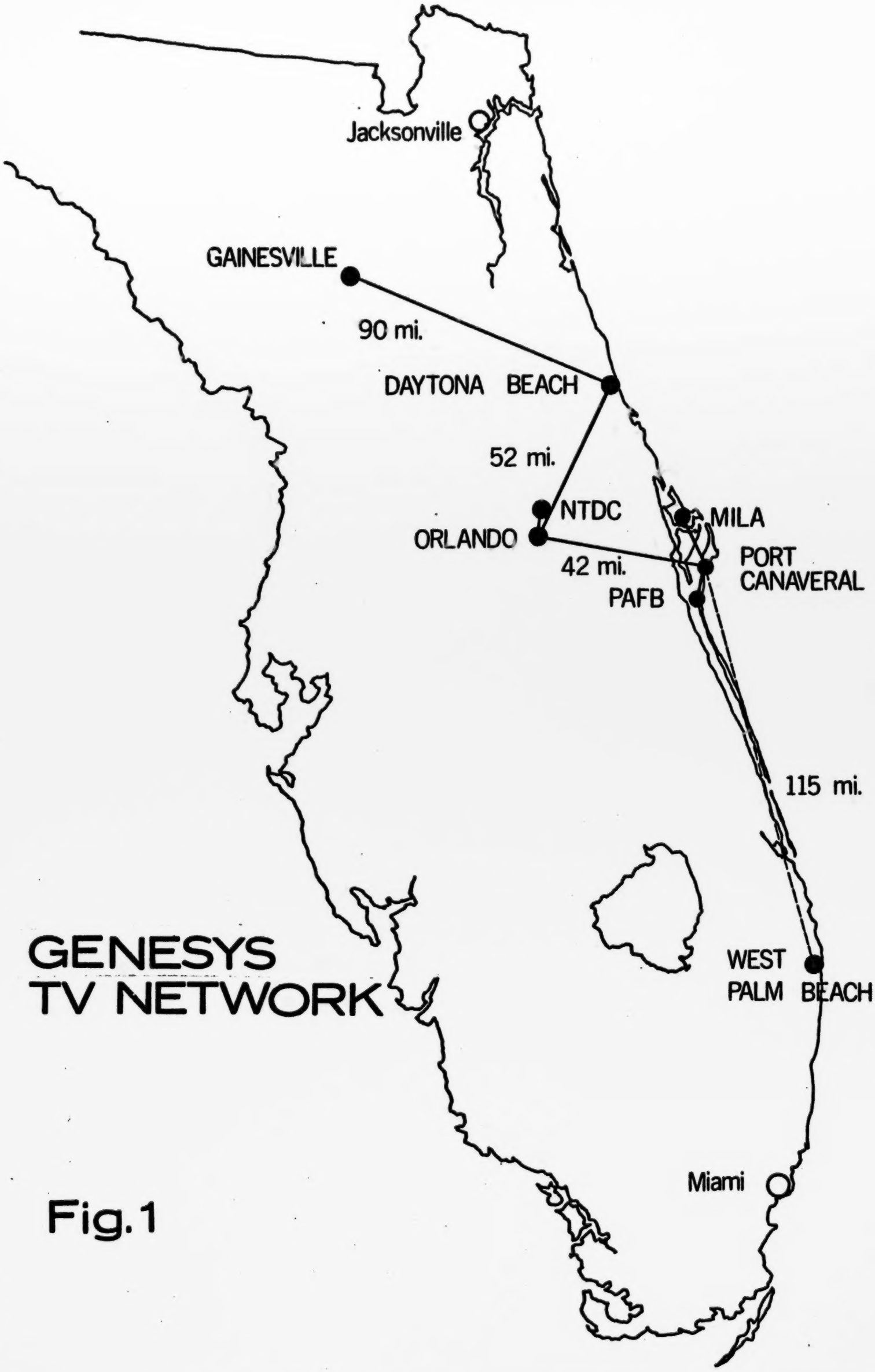
Jacksonville
GAINESVILLE
90 mi.
DAYTONA BEACH
52 mi.
NTDC
ORLANDO
MILA
42 mi.
PORT CANAVERAL
PAFB
115 mi.
WEST PALM BEACH
Miami
GENESYS TV NETWORK

Fig.1

A. Teaching console

B. Chair

C. Overhead TV camera (zoom lens)

D. TV monitor (for students)

E. Control room

F. TV monitor (for lecturer)

G. Standard lectern

H. TV camera (zoom lens, pan, scan)

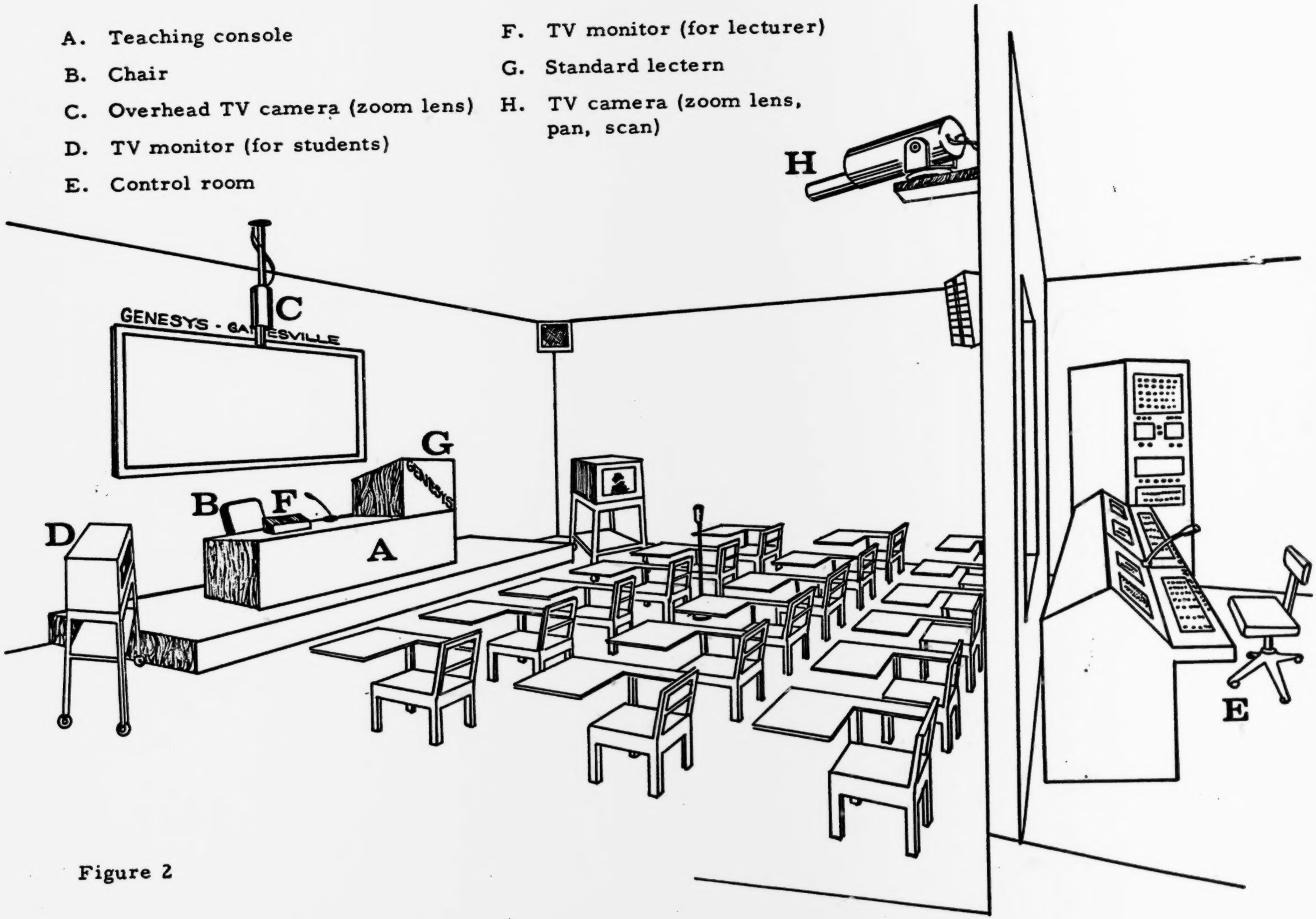

Figure 2

The entire building program to date at the new centers consists of one combination classroom-office building at Daytona Beach, two combination classroom-office buildings at Orlando, three combination classroom-laboratory-office buildings and one auditorium at Port Canaveral, and one classroom-office building at West Palm Beach. Extending GENESYS to West Palm Beach was approved by the 1967 Florida Legislature. All of these buildings are finished and in use except one at Orlando and one at West Palm Beach. These two buildings should be under contract before summer and ready sometime during the Fall Quarter. Current expansion of the building program was made possible by a Title II Grant from the Office of Education.

There are fully equipped studios at all locations. Construction plans for West Palm Beach include both studio and control room. However, the equipment will not be installed until needed. All studios are similar in both design and size and have a mass capacity of 25 students each.

As indicated in Figure 1, all centers are connected through intercity microwave circuits. Each microwave circuit carries one video and two audio channels. Network switching at each center allows lectures and demonstrations from that center to be switched into the microwave transmission system. Since a course can be originated at any center (except West Palm Beach) there are many combinations of course transmissions available. For instance, a course originating in Gainesville could terminate at Orlando leaving the circuit from Orlando to the Cape open to carry a course originating in Orlando. Every effort is made to maximize the number of student registrations. A preregistration survey is made prior to the start of each term, and course offerings

are based on this survey. Some last minute adjustments are still required, however, as the term begins.

Operating Procedures

The GENESYS program envisioned a small number of students at each of the centers enrolled for the same course which would be taught by a high quality graduate faculty member. Consequently each center contains two small (6 men) monitoring rooms which were to take care of these small groups. Three or more normal-sized classrooms with folding walls, to expand or subdivide them, were included to handle local classes. Each center also has library space and offices for the resident faculty.

Because the concept of teaching graduate programs over TV was new, it was decided to lease lines from the Southern Bell Telephone Company rather than invest in our own microwave system. The centers are connected by regular closed circuit microwave TV lines with one-way video but two-way audio as shown in Figure 3. Thus a student can ask questions of the lecturer although he will not be seen by the lecturer. A listing of the cameras and related equipment in use at each Center is presented in Appendix A.

The system was planned to operate as follows. The professor conducting the class would have a live class in front of him in the TV studio. His lecture would be televised via closed circuit to the various centers where one or more students wanted to take the course. Although the original concept was to use the traditional blackboard system of lecturing with a TV camera picking up the image on the blackboards, many of the teaching faculty complained about certain

GENESYS TV NETWORK

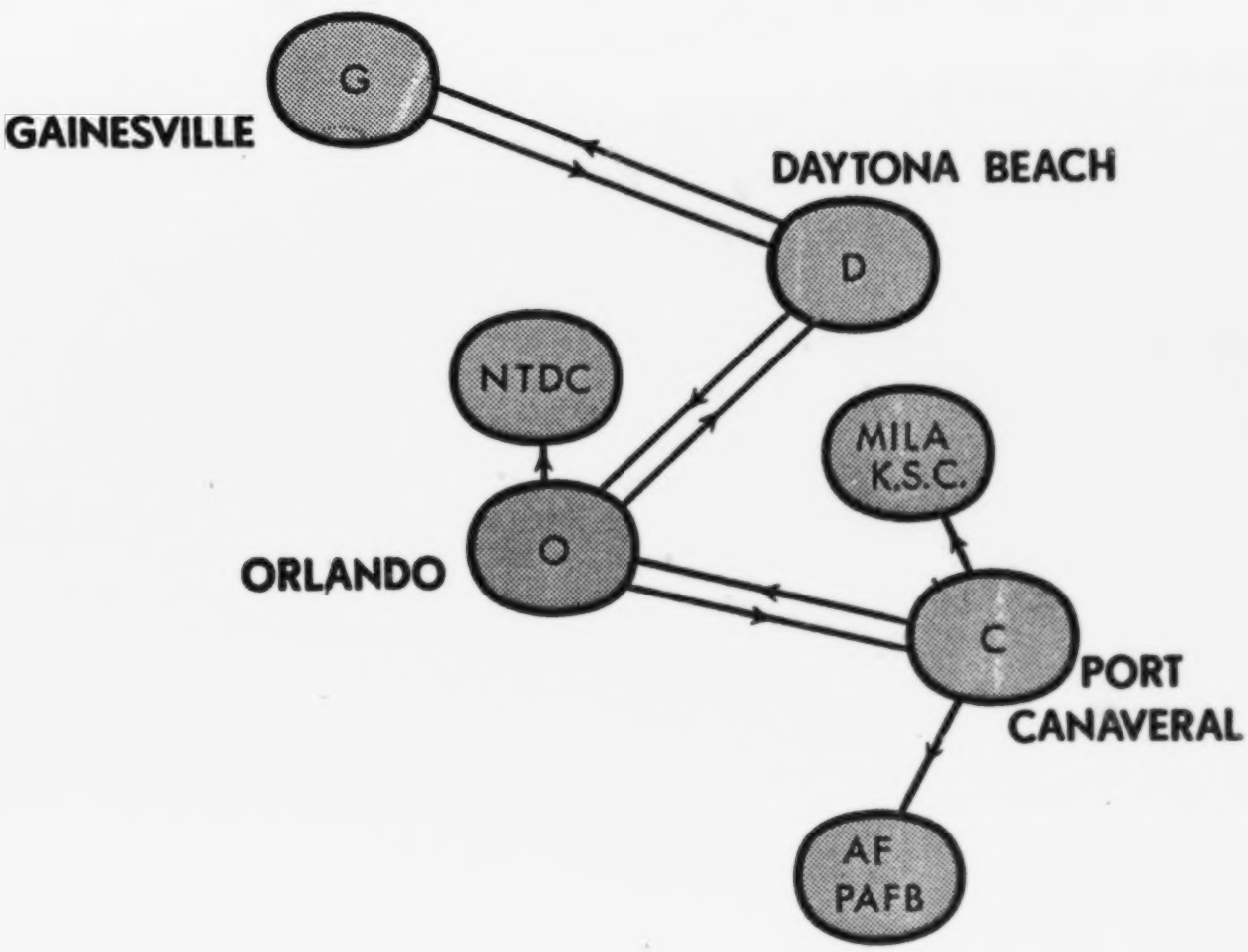

Fig.3

limitations of this system. After some experimentation we now place a TV camera above the desk of the instructor and let him write his lecture with one of the modern felt-tipped pens. The camera has a zoom lens which enables the operator to obtain a good image on the monitors. Also in front of the instructor is a small monitor in which he can see what is going out over the system. A second camera remotely controlled is located at the back of the class and views the full blackboard and the instructor scene. There are some controls that can be handled by the instructor as well as by the operator in the control room.

The two-way audio system was used to allow the student to ask questions just as though he were in the classroom. In order to give the professor some control, a location panel was installed in the back of the classroom which would indicate a particular location when the remote student pressed the proper button on the telephone hand set located near his desk. The professor could then call on the student for his question when appropriate. The student could then use the push-to-talk button on the hand set and ask his question. All students on the system could hear the question and, of course, the answer.

The station identification panel was apparently not used very much because the professor soon recognized the voices of the students and thus made it unnecessary for the student to activate the panel lighting button. Since this particular circuit accounted for about 4 percent of the system cost, it was discontinued. If there were large classes at each center, the panel would probably be useful and worth the cost.

Quizzes are prepared by the lecturer, wherever he may be, and mailed to the centers where the resident faculty hand them to the students, collect the papers, and send the completed exam back to the lecturer for grading.

The first television classes were conducted in May, 1965, and the program was deemed a success by both the participating faculty and the students. There were many bugs in the system that had to be worked out, but these were solved with the minimum amount of frustration, in the fine spirit of cooperation between faculty, students, and administrators. Today the system is working smoothly and only a few justifiable complaints are heard.

To enhance the course work and to make the program as nearly as possible equivalent to those on the Gainesville campus, the IBM 360-50 computer at Gainesville was made available this year to all centers via telephone lines and data terminals. The computer is available to the students and faculty at these centers for two periods each day.

Some faculty members at the centers are conducting research and are using the computer via telephone lines at the remote terminals. The leased lines used for this purpose were obtained as regular voice telephone lines to the centers and were given Gainesville campus numbers. This was found to be only slightly more expensive than long distance toll charges, and provided much closer ties between the Gainesville faculty and their students at the outlying centers.

GENESYS students are required to complete essentially the same course program as the Gainesville campus students although there are necessarily some

deviations for individual cases. All students who obtain a Master's degree in engineering are required to take a departmental examination which is oral and/or written. The examination is given on the Gainesville campus and is prepared and monitored by a faculty committee. Since all College of Engineering candidates for the Master's degree take the same departmental examination, there is adequate assurance that the student who has received all of his instruction at the centers away from Gainesville, and has passed the examination, is about as well qualified for the degree as the Gainesville-educated student.

Cost Analysis

In education as well as in most everything else today, cost has become a very important factor. In reviewing the cost of operating GENESYS, after some experience, it was found that it was very nearly the same as the Gainesville campus program. The following calculations illustrate the way we arrive at this conclusion.

The analysis is based on the cost per student semester hour, i.e., the unit cost to teach a one-semester hour to one student. (The cost of the buildings is omitted from the comparison since we are concerned only with the annual operating costs.) The annual GENESYS expenditure for salaries, expense, and equipment is about $600,000. During the fiscal year, 1966/67, we taught about 4,500 student semester hours to students not on the Gainesville campus giving us a figure of $133 per student semester hour. Any course that was taught in Gainesville and transmitted to the other campuses was charged to GENESYS even though it would have been given to only the Gainesville

students had there not been a demand for placing it on the TV network. This means that the $133 per student semester hour is a conservative cost estimate.

Calculating an accurate cost of teaching graduate engineering courses on the Gainesville campus presents a difficult problem, but an estimate may be made as follows. Assume that one professor with a salary of $1,600 per month teaches three 3-semester-hour graduate courses as an equivalent full load; that he averages eight students per class and teaches for four months (one trimester).

$$\text{cost per SSH} = \frac{\$1,600 \text{ X } 4 \text{ months}}{3 \text{ X } 8 \text{ students X } 3 \text{ semester hour/course}} = \$88.88$$

This is the direct cost to which must be added all the indirect costs. Let us assume the indirect costs to be about 50 percent of the direct costs. Thus the Gainesville campus cost would be about $133 which, amazingly, is identical with the GENESYS cost.

One of the major expenses of the system is the cost of the telephone lines. It is very probable that this factor could be reduced appreciably if one could install his own microwave system. It is obvious that one should make a thorough study of each particular application before deciding on the most economical and satisfactory method of carrying the information from the originating source to the students.

Initial Experience

What has been the result of this venture into a new system of providing graduate engineering education at locations considerably removed from a college

of engineering campus? Although GENESYS offered course work during the 1964/65 academic year at the centers, the program did not get into full swing until the following autumn. The TV system was placed in operation in May, 1965, and was fairly well established by Fall with a full schedule of courses.

It was recognized by the College and University faculty that a substantial part of the course offerings must be taught by full-time faculty members. The remainder of the courses may be taught by qualified industry-employed part-time lecturers. Each of the centers has a complement of full-time faculty members with an assistant professor and a professor at Daytona Beach, an assistant professor and professor at Orlando, two unfilled positions at West Palm Beach, and one assistant professor, three associate professors and three professors at Port Canaveral. Secretaries and technicians are provided at the centers as required. The center resident faculty provides most of the student counseling.

The courses are scheduled for one hour and 15 minutes on two days a week, generally Monday and Wednesday or Tuesday and Thursday. The first course starts at 6:30 a.m. and the last course ends at 9:55 p.m. with a full schedule in between. Figure 4 shows the schedule for the Fall of 1967. Maintenance time, graduate seminars, conferences and short courses are scheduled for both Friday and Saturday and sometimes on Sunday.

Tables I and II show the student participation since the beginning of GENESYS and the number of Master's degrees awarded. Changes in the number of students enrolled appears to correlate somewhat with the NASA effort in

PERIOD	MONDAY WEDNESDAY	TUESDAY THURSDAY	PERIOD	MONDAY WEDNESDAY	TUESDAY THURSDAY
6:30 AM G-1 7:45 AM	ISE 670 - STANFEL MS 505 CARROLL	STA 540 IRELAND	1:35 PM G-6 2:50 PM	ESM 536 HEMP MS 501 WELCH	MTL 540 REED-HILL EE 651-12 SIMONS
7:55 AM G-2 9:10 AM	CE 675 DEAN ISE 604 LEAVENWORTH	ISE 682 PROCTOR EE 522 WALKER	3:00 PM G-7 4:15 PM	ISE 570 SIVAZLIAN	EE 640-11 GEORGE EE 692-13 MANDERS
9:20 AM G-3 10:35 AM	MS 502 WELCH	MTL 300 EMBRY-RIDDLE-SANWALD EE 634-12 WALTER	4:25 PM G-8 5:40 PM	MTL 520 GUY ISE 622 LEAVENWORTH	ME 560 IREY ASE 691 ARTHUR
10:45 AM G-4 12:00 AM	ME 656 OLIVER EE 631-11 WALTER EE 600-12 JONES	ISE 601 THOMAS	5:50 PM G-9 7:05 PM	EE 591-12 SHAFFER EE 561-12 HUMMER	ISE 580 PROCTOR EE 641-12 MANDERS
12:10 PM G-5 1:25 PM	ISE 611 BURNS "MONDAY ONLY" EGC (R-1) HUMMER	ISE 550 - VICKERS "THURS. ONLY" EGC (R-1) HUMMER	7:15 PM G-10 8:30 PM	ME 681 MAHIG EE 474-13 JONES	EE 630-11 O'MALLEY ASE 570 WILLIAMS, D.T. JSA 440 BUSH
			8:40 PM G-11 9:55 PM	EE 691-11 LINDHOLM EGC 611 ARTHUR	MS 503 McRARY

Fig.4

TABLE I

GENESYS Enrollments & Class Registrations - Fall 1964-Winter 1968

							Trimester→			← Quarter	
	1964	1965	1965	1965	1966	1966	1966	1967	1967	1967	1968
Location	F	W	S	F	W	S	F	W	S	F	W
DAYTONA											
Enrollment	32	61	62	98	114	77	114	79	49	54	53
Class Regis	41	94	103	173	163	115	160	116	71	82	81
CAPE											
Enrollment	74	88	76	141	100	77	149	136	103	162	130
Class Regis	89	109	91	189	123	92	185	175	130	207	176
ORLANDO											
Enrollment	115	104	95	161	140	133	205	204	118	172	166
Class Regis	141	128	112	191	158	157	252	238	138	205	188
TOTALS											
Enrollment	221	253	233	400	354	287	468	419	270	388	349
Class Regis	271	331	306	553	444	364	597	529	339	494	445

TABLE II

GENESYS Degrees Awarded - April 1965-December 1967

							Trimester→		←Quarter
	Apr	Aug	Dec	Apr	Aug	Dec	Apr	Aug	Dec
Location	1965	1965	1965	1966	1966	1966	1967	1967	1967
DAYTONA	-	-	4	9	9	5	8	4/1	2
CAPE	1	-	1	2	-	4	5	3/1	3
ORLANDO	3	3	4	5	2	7	4/1	6	-
TOTALS	4	3	9	16	11	16	18	13/2*	5

GRAND TOTAL = 97

* 13/2 = 13 M.E., 2 M.S.E.

Florida. Please note that up through the Spring of 1967, the University of Florida was operating on a Trimester system (three equal terms in the calendar year) but starting with the Fall of 1967 the University is operating on the Quarter system (four equal terms per calendar year).

Most of those who have worked with the GENESYS system are of the opinion that it has provided a very effective means for bringing graduate engineering education to a large number of employed engineers in Florida. It would have been impossible to have accomplished so much without the TV network. It is also believed that the extension of the system to West Palm Beach will increase the student participation in that area and may possibly be the incentive to have it extended into the industrial area farther to the south. It is predicted that GENESYS will teach 1,800 quarter hours in 1970 and 3,800 in 1975.

It should also be recognized that this system could utilize Florida's manpower resources much more effectively if the major universities in the State were linked with a closed circuit TV network. This would allow the graduate students in all universities to hear the lectures of an outstanding professor without having to travel to that professor's classroom.

No one should believe that closed circuit TV is the answer to all problems in getting education into non-university areas but it will no doubt prove to be one of the most effective methods of providing graduate education to mature students in the distant areas.

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APPENDIX A

Equipment List

Gainesville

1. Camera, studio, remote control; pan, scan, zoom lens used for general coverage.

2. Camera, studio, remote control; zoom lens used overhead at instructor's desk.

3. Camera, mobile console, remote control; pan, scan, zoom lens.

4. Projector, large screen TV (Tele-Beam) used in auditorium to make presentations to audience up to 200 persons.

All cameras are by Dage. All zoom lenses are Model X by Angenieux. Remote control equipment mobile console, switches, network, etc., designed by GENESYS TV engineers and either constructed by GENESYS personnel or purchased on bid.

Daytona Beach

1. Camera, studio, by G.E.; zoom lens Model X by Angenieux; remote control, pan, scan used for general coverage.

Remote control equipment, switches, network designed by GENESYS TV engineers and constructed by GENESYS personnel or placed on bid.

Orlando

Same as Daytona Beach except cameras are Dage.

Port Canaveral

Practically the same as Gainesville.

Original cost per studio, such as Daytona Beach, $21,000.

Original cost per receiving facility which includes furnishing two small (5 seats each) and one large (34 seats) classrooms, $5,500.

Installation charges by the telephone company are in addition to the above.